

Introduction to Botany. Lecture 38

Alexey Shipunov

Minot State University

December 11, 2013



1 Questions and answers

2 Seed plants

- Flower
- Flower development: ABC model
- Primitive flowers
- Four subclasses of angiosperms
- Pollination
- Inflorescences



1 Questions and answers

2 Seed plants

- Flower
- Flower development: ABC model
- Primitive flowers
- Four subclasses of angiosperms
- Pollination
- Inflorescences



Previous final question: the answer

What is a double fertilization?



Previous final question: the answer

What is a double fertilization?

- 1st sperm cell (1st spermatium, n) + egg cell (n) = zygote ($2n$)
- 2nd sperm cell (2nd spermatium, n) + central cell ($2n$ or sometimes n) = mother cell of endosperm₂ ($3n$ or sometimes $2n$)

In all, the second fertilization is a **signal** that first fertilization has been occurred. Endosperm₂ develops from the “signalized” female gametophyte.



Seed plants

Flower



Definition of flower

- Compact generative shoot (= floral unit, FU) with three zones
- Three main zones: sterile (perianth), male (androecium) and female (gynoecium)
- General characters: sex, merosity, symmetry, position of gynoecium

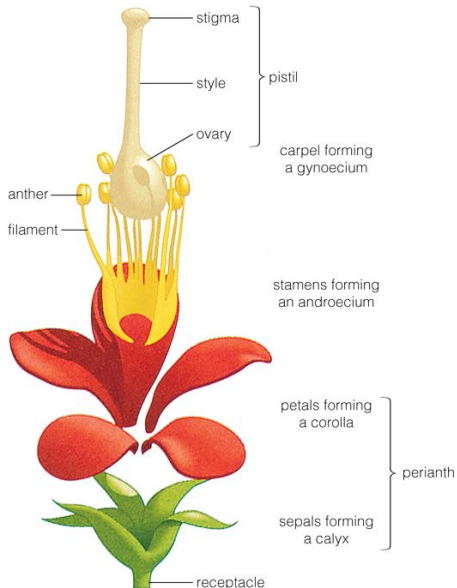


Structure of flower

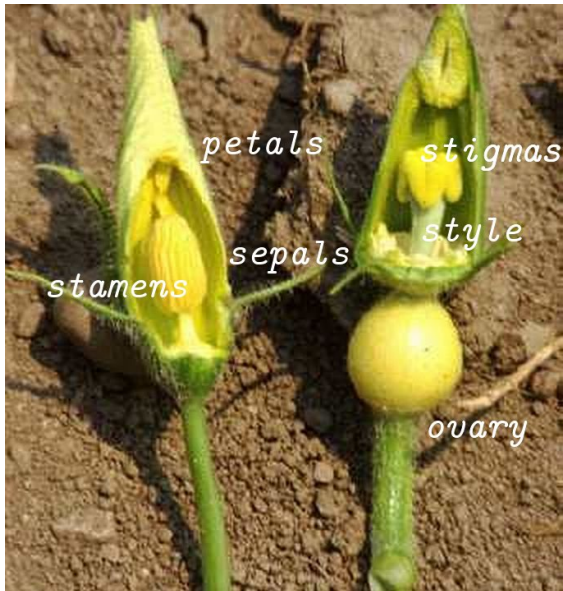
- Perianth
 - Simple perianth (consists of tepals)
 - Double perianth
 - Calyx (consists of sepals)
 - Corolla (consists of petals)
- Androecium (consists of stamens)
 - Filament
 - Anther (consists of pollen sacs)
- Gynoecium (consists of pistils)
 - Ovary (consists of carpels)
 - Style
 - Stigma



Structure of flower



Pumpkin (*Cucurbita pepo*) flower



Seed plants

Flower development: ABC model

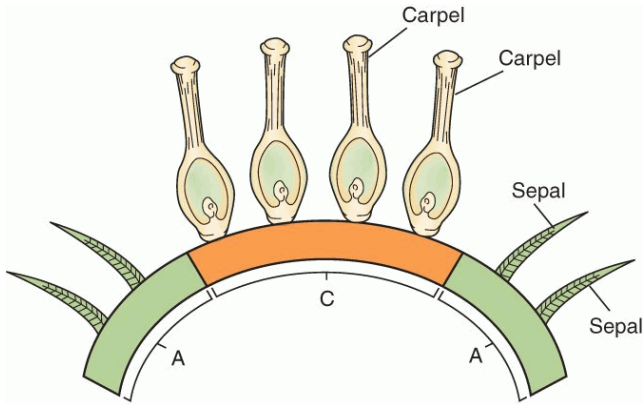


ABC-genes

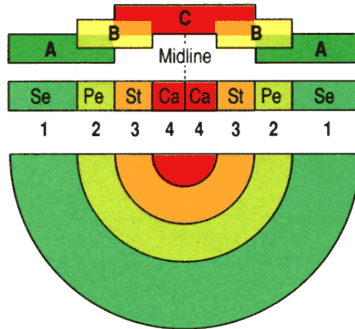
- There are 3 classes of genes expressed in overlapping, concentric rings.
- The A class (like *apetala2* gene) is expressed in the outermost ring and C (like *agamous*) is expressed in the center; B (e.g., *apetala3*) is expressed at the boundary of A and C.
- If A is expressed in a cell, it goes on to form a sepal.
- If C is turned on, it forms a carpel.
- Petals are formed where both B + A are active.
- Stamens are formed with the combination B + C.



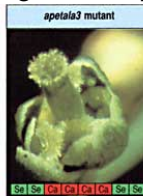
A and C genes “make” sepals and pistils



B genes “transform” them into petals and stamens



Corresponding *Arabidopsis* mutants:



Seed plants

Primitive flowers

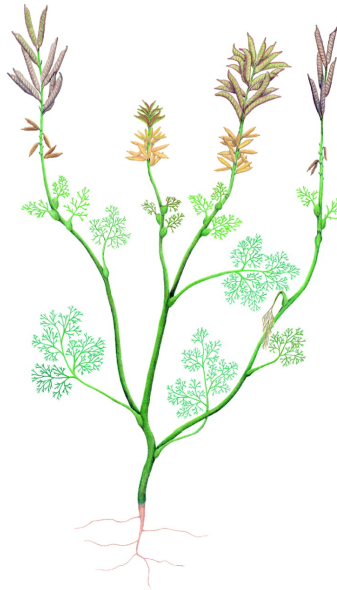


Archaeofructus

- Fossil water plant from lower Cretaceous of China
- Very primitive fructifications which are not yet compacted in flower
- Multiple free carpels, paired stamens



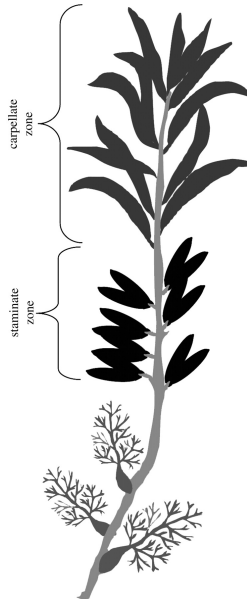
Archaeofructus reconstruction



Archaeofructus reconstruction, 3D



Archaeofructus, scheme of “flower”



Amborella

- Small forest shrub of New Caledonia (big island in Pacific ocean)
- Have irregular flowers, stilar canal, unusual embryo sac (with three synergids and no antipods)



Amborella, branch with male flowers



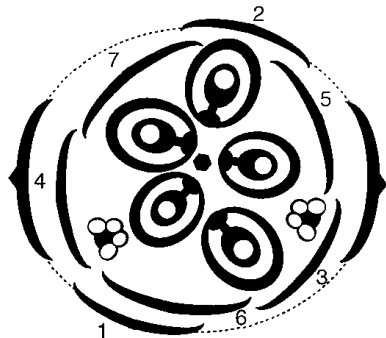
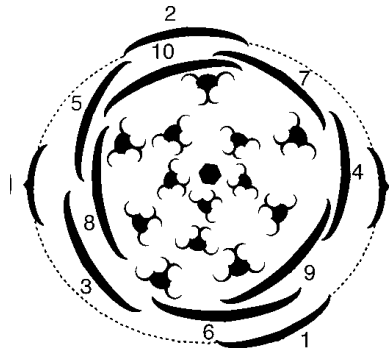
Amborella, male and female flowers



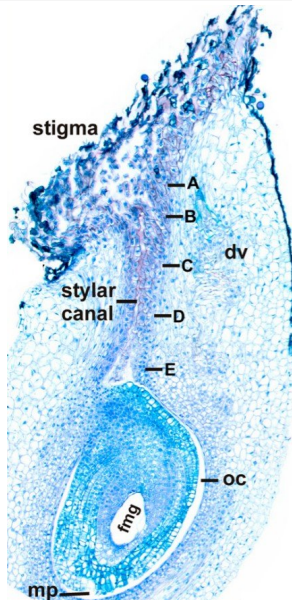
© Joel McNeal



Amborella, diagrams of male and female flowers



Amborella stylar canal

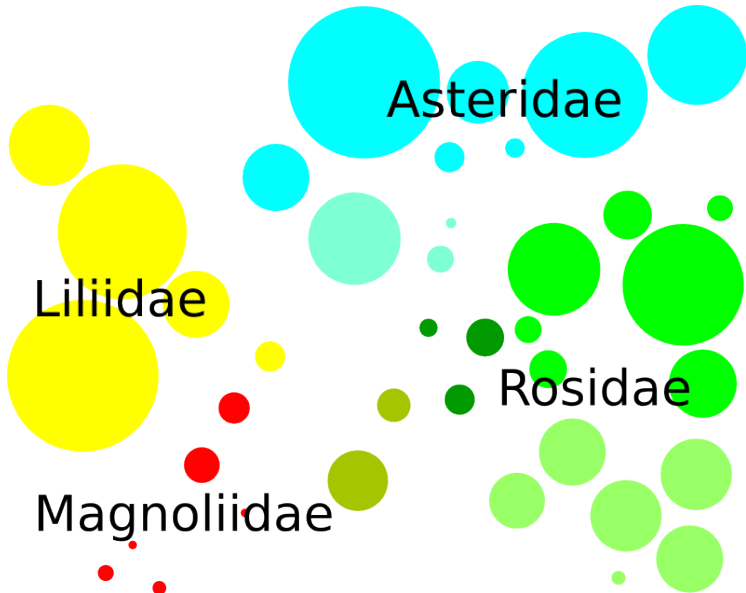


Seed plants

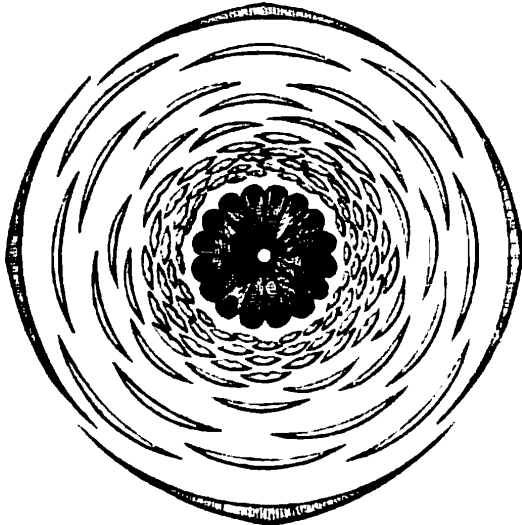
Four subclasses of angiosperms



Angiosperms: subclasses and orders



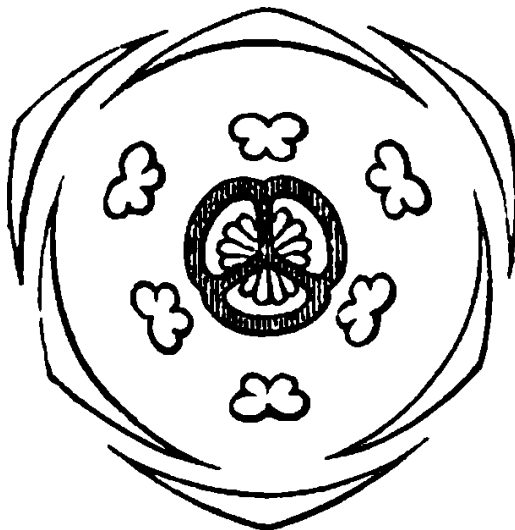
Magnoliidae portrait



Nymphaea sp. (water-lily)



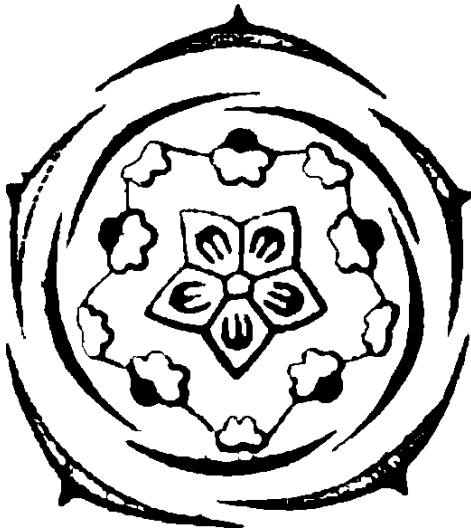
Liliidae portrait



Acorus calamus (calamus, or sweet flag)



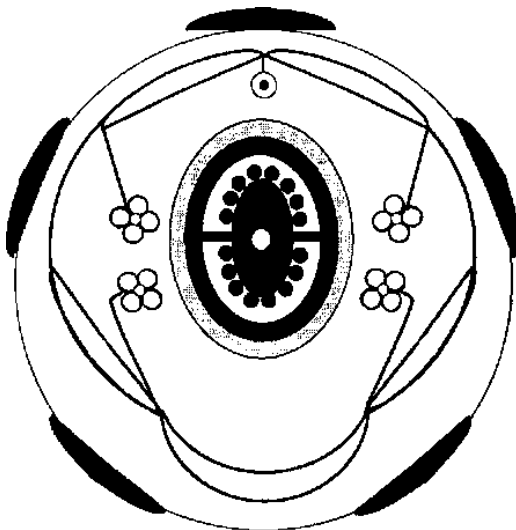
Rosidae portrait



Geranium sp. (wild geranium)



Asteridae portrait



Penstemon sp. (beard-tongue)



Seed plants

Pollination



How to avoid pollination: apomixis

- Apomixis is a reproduction with reproductive organs but without fertilization
- **Apospory**: embryo develops from maternal diploid tissue, without meiosis; here asexual reproduction becomes vegetative
- **Apogamy** (i.e., parthenogenesis): embryo develops from unfertilized gamete after diploidization; sexual reproduction becomes vegetative



Pollination

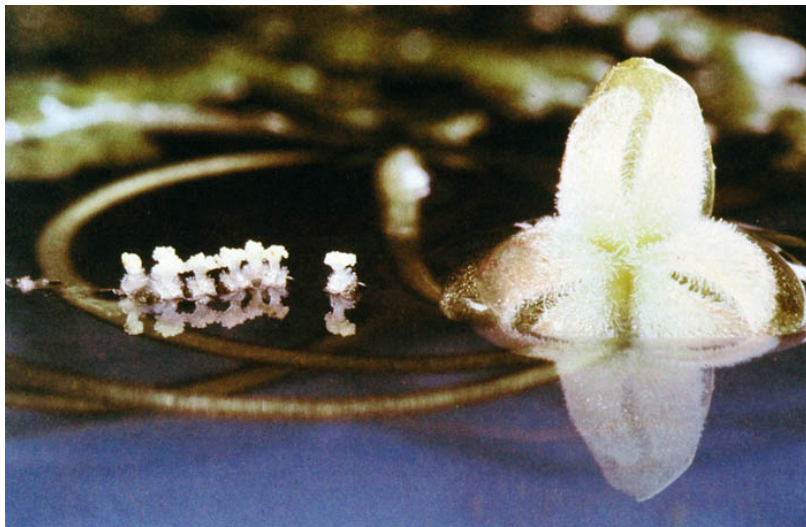
- Self-pollination (only slightly better than apogamy)
- Cross-pollination: abiotic (gravity, wind, water) and biotic (insects, birds, bats, sometimes even possums)
- Every pollination type has associated **pollination syndrome**



Wind pollination: hazelnut



Water pollination: vallisneria



Bat pollination: cacti



Possum pollinator: Australian Myrtaceae



Seed plants

Inflorescences



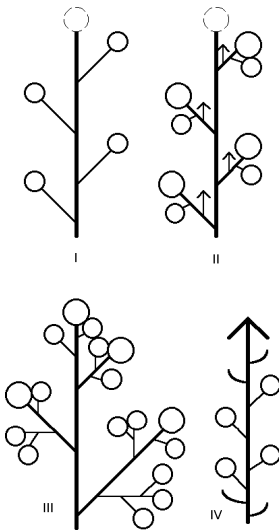
Types of inflorescences

Inflorescence is an isolated generative shoot bearing flowers

- Model I. Raceme and its derivatives
 - Simple: raceme (developed main axis, developed lateral axes: 11), spike/catkin (developed main axes, reduced lateral axes: 10), umbel (01), head (00)
 - Compound: compound raceme (11/11), compound umbel (01/01) etc.
- Model II. Thyrsus and its derivatives
 - Reduced (cymes): dichasium, cincinnus (scorpioid inflorescence) etc.
 - Thyrses in a strict sense
- Model III. Closed panicle (also umbel-like panicles)
- Model IV. Intercalary inflorescences



Models of inflorescences



Final question (2 points)



Final question (2 points)

What is a flower?



Summary

- **Flower** is a compact three-zoned generative shoot
- Three main zones of flower: sterile (**perianth**), male (**androecium**) and female (**gynoecium**)
- **ABC-genes** determine the fate of cells which are forming flower
- **Inflorescence** is an isolated generative shoot bearing flowers



For Further Reading



A. Shipunov.

Introduction to Botany [Electronic resource].

2010—onwards.

Mode of access:

http://ashipunov.info/shipunov/school/biol_154



Th. L. Rost, M. G. Barbour, C. R. Stocking, T. M. Murphy.

Plant Biology. 2nd edition.

Thomson Brooks/Cole, 2006.

Chapters 13 and 25.

